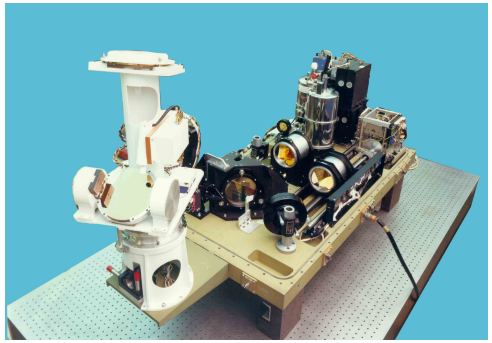


MkIV/JPL Site Report

Geoffrey Toon, Jean-Francois Blavier, Keeyoon Sung

Jet Propulsion Laboratory, Caltech Institute of Technology

Not a primary NDACC site, so MkIV/JPL doesn't show up in Jim's reports, but dataset is still potentially useful

MkIV is now 29 years old, still with original KBr beamsplitter/compensator.

Instrument covers entire 650-5650 cm^{-1} region simultaneously (no filters) at 0.005 cm^{-1} resolution (117 cm MOPD) for ground-based obs.

~1000 days of ground observations, 22 balloon flights, and 30+ aircraft flights.

Ground-based dataset has many interruptions due to balloon/aircraft campaigns

Highlights of 2012

Repaired MkIV following damage from Sep 2011 balloon flight

Resumed ground-based measurements from JPL

Replaced 21-year-old SpectraPhysics reference laser with REO Model 32734. (Still working, but power was down by factor 2 and easily went into wait mode)

MkIV instrument continues to make measurements from JPL. Although this site is sometimes polluted, this expands the scientific usefulness of the measurements.

Submitted a single Ames-format file to Jeanette Wild covering 1985-2013 ground-based MkIV observations from 12 different locations. There are 3400+ observations acquired on ~1000 different days.

New MkIV ground-based dataset

Re-analysis covers 1985 to 2013 time period

~1000 observation days

6800+ observation (HgCdTe + InSb spectral pairs) covering 650 to 5650 cm^{-1}

12 measurement locations from 78S to 68N are included in single file

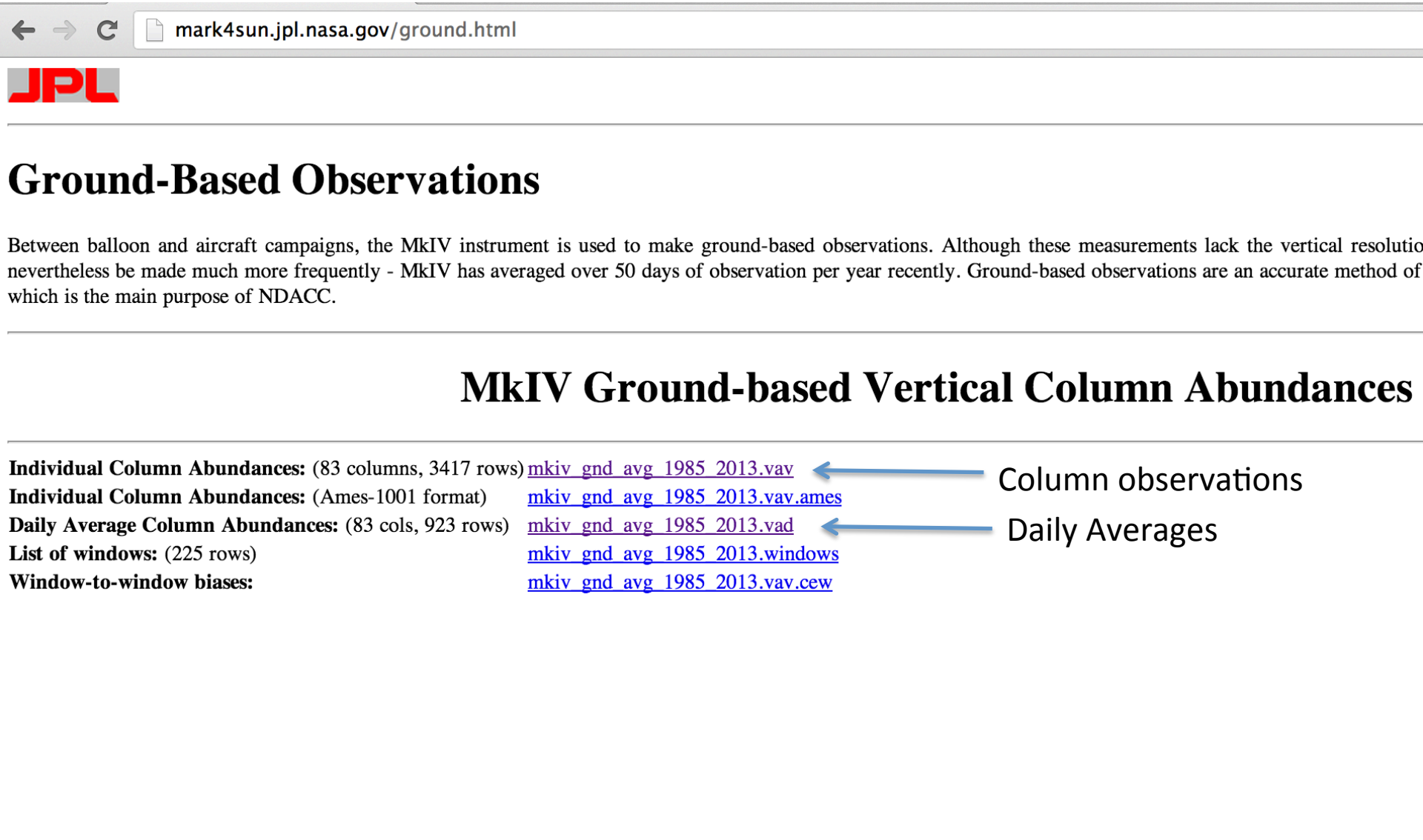
All data measured with same instrument (BS, detectors, etc) and analyzed with the same methodology (IPP, GFIT, linelist, etc)

- GFIT Version 4 analysis (same as used for TCCON)
- Tweaked spectroscopic linelist mostly based on HITRAN 2008

Dataset submitted to NDACC archive

Also available from: http://mark4sun.jpl.nasa.gov/ground.html

mark4sun.jpl.nasa.gov/ground.html



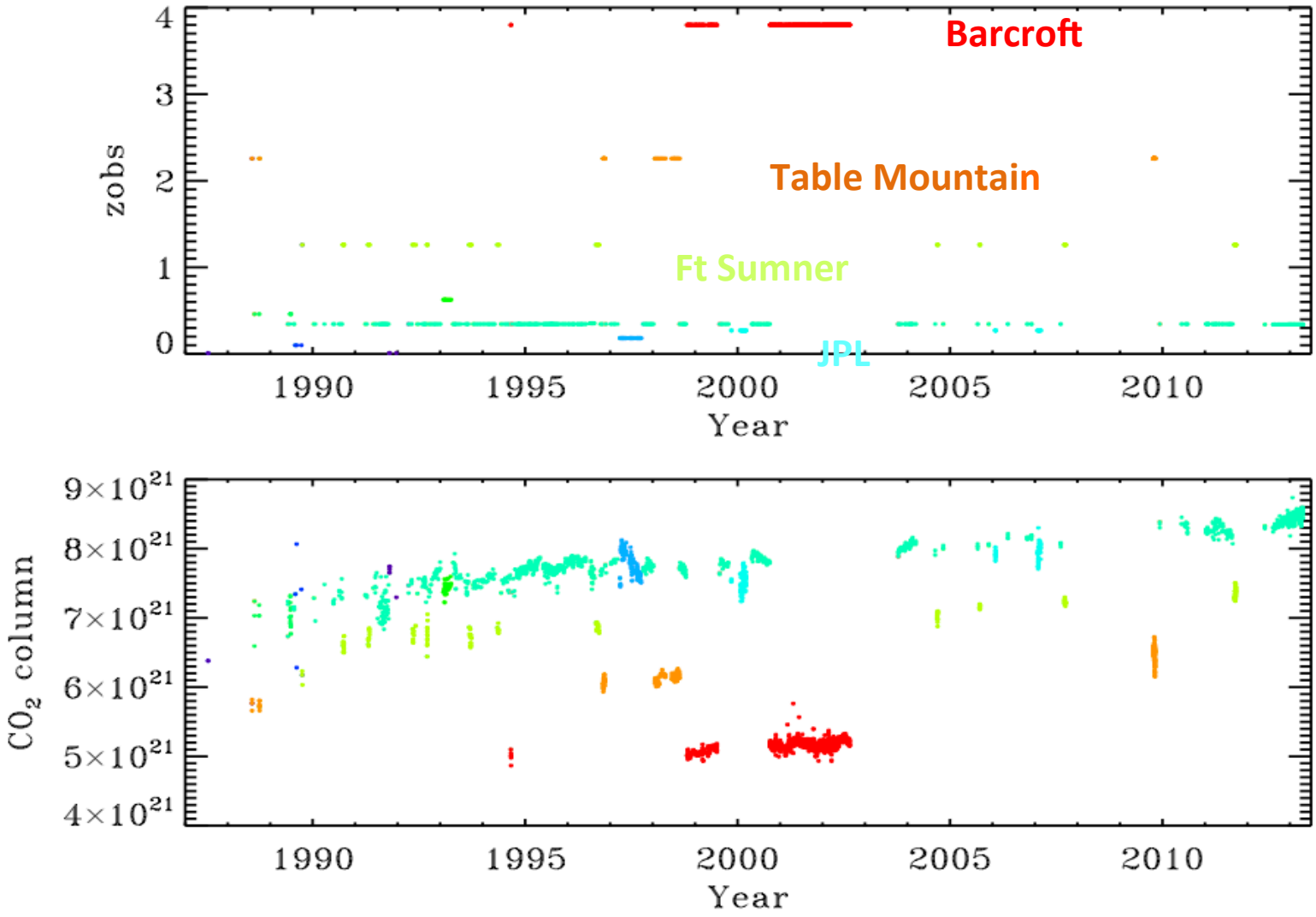
MkIV dataset covers 12 locations

Location	Key	Nobs	Latitude (deg.)	Longitude (deg.)	Altitude (km)
Esrange, Sweden	ESN	160	+67.889	+21.085	0.271
Ft Wainwright, Fairbanks, Alaska	FAI	124	+64.830	-147.614	0.182
Lynn Lake, Manitoba, Canada	LYL	20	+56.858	-101.066	0.354
Mt. Barcroft, California	MTB	1369	+37.584	-118.235	3.801
ARC, Mountain View, California	ARC	7	+37.430	-122.080	0.010
Daggett, California	DAG	33	+34.856	-116.790	0.626
Ft Sumner, New Mexico	FTS	172	+34.480	-104.220	1.260
TMF, Wrightwood, California	TMF	475	+34.382	-117.678	2.257
JPL B183, Pasadena, California	JPL	758	+34.199	-118.174	0.345
JPL Mesa, Pasadena, California	JPL	20	+34.205	-118.171	0.460
NSBF, Palestine, Texas	PAL	4	+31.780	-95.700	0.100
McMurdo, Antarctica	MCM	37	-77.847	+166.728	0.100

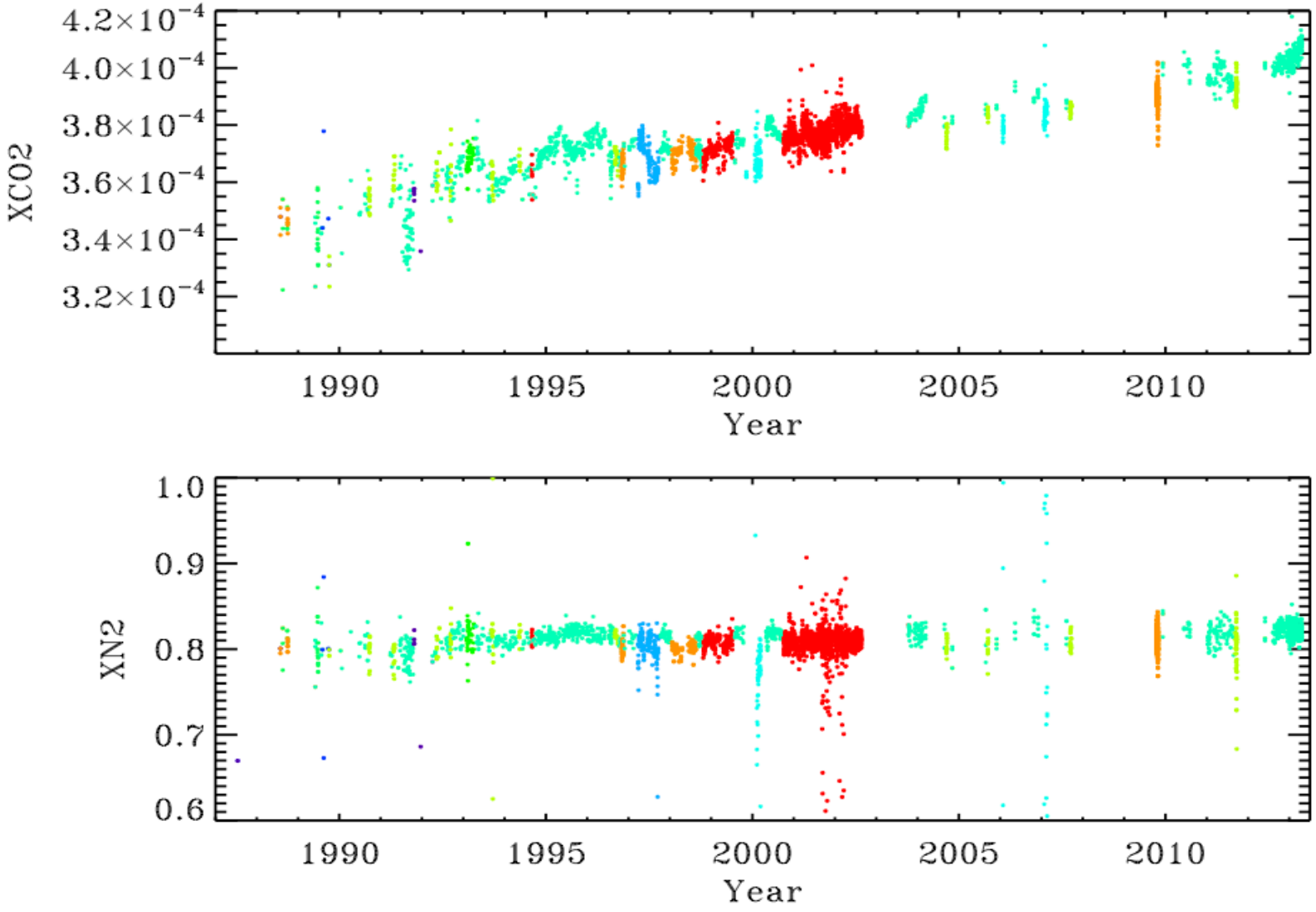
Nobs = Number of Observations; +ve Latitude = N; +ve Longitude = E

MkIV dataset is unique in the sense that the same instrument and analysis method has been applied to 12 different locations, minimizing site-to-site biases.

MkIV CO_2 Columns

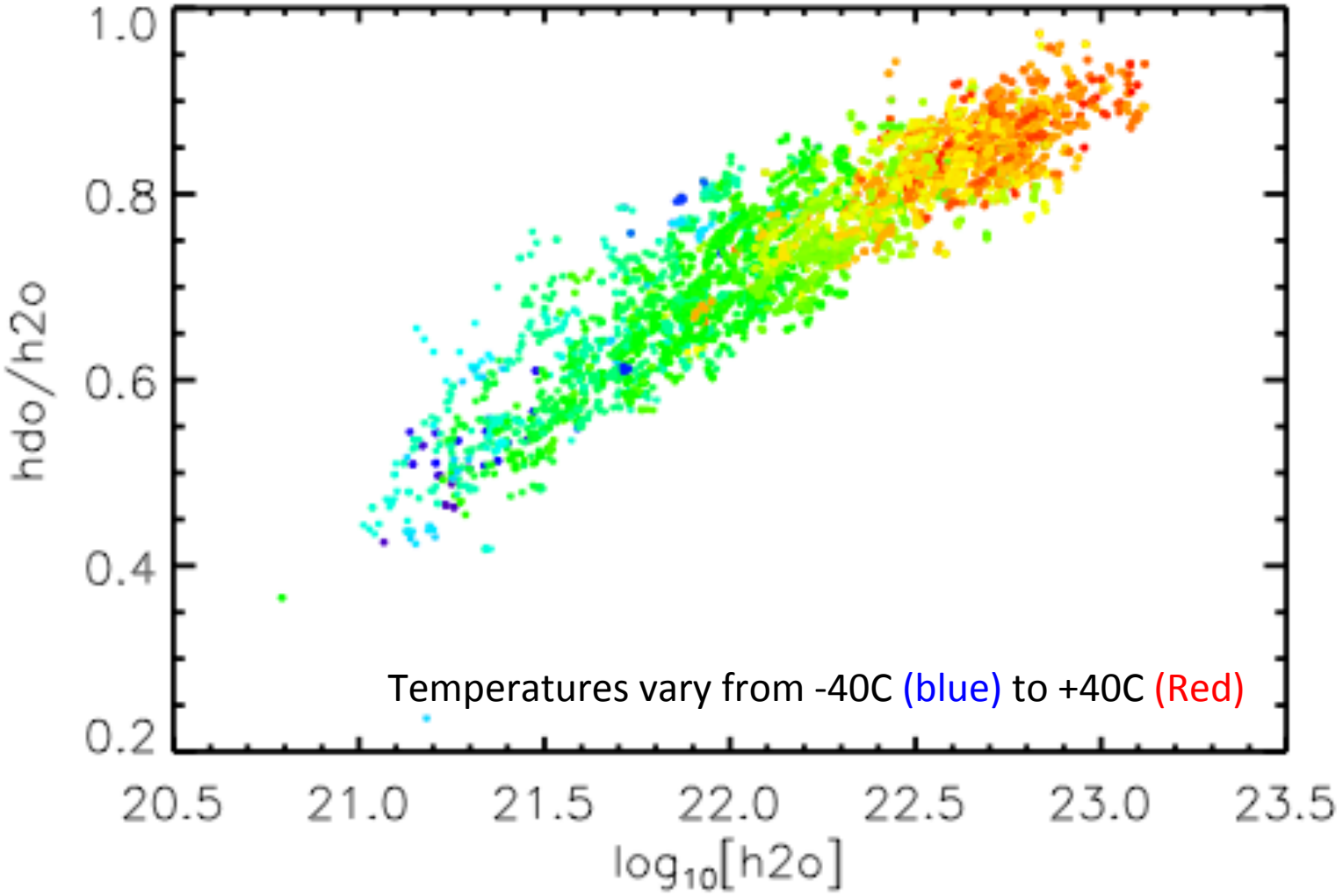


XCO_2 and XN_2

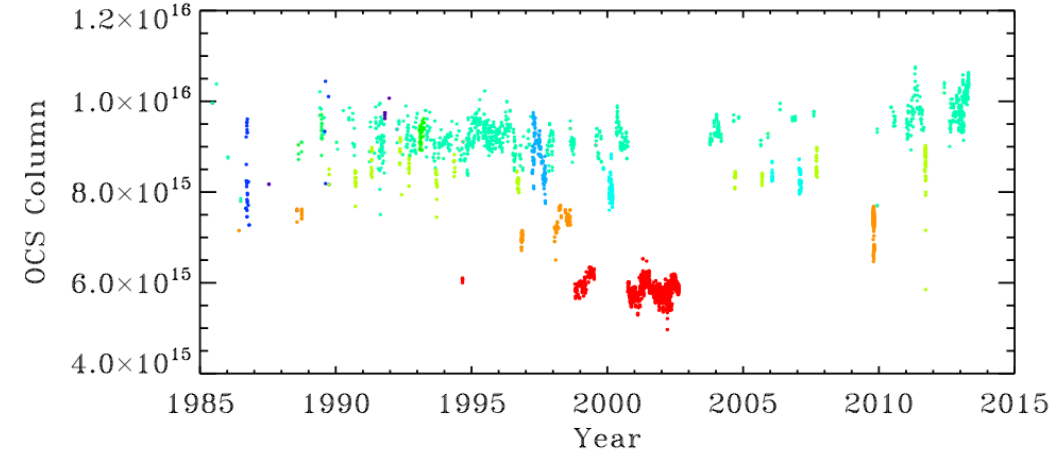


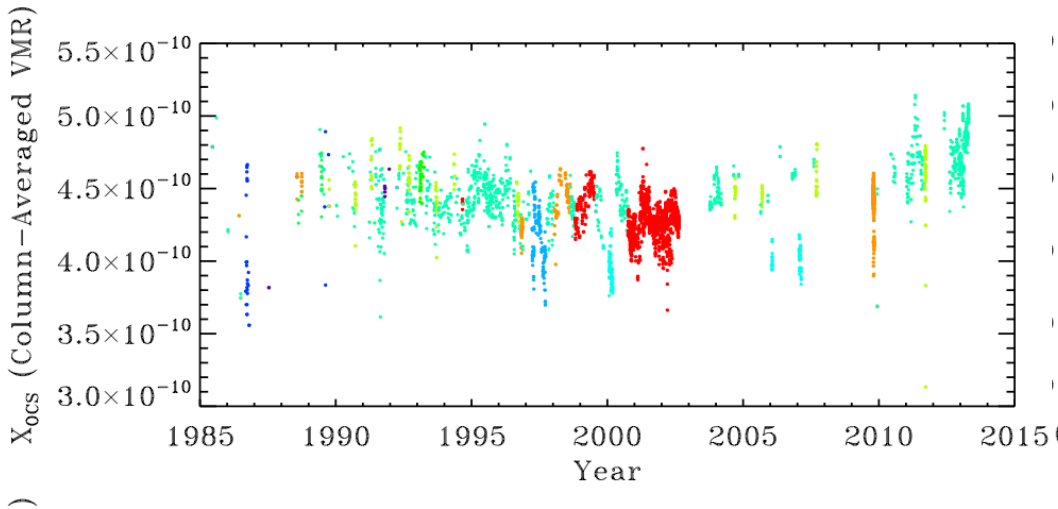
Need to de-seasonalize the CO2 (which is latitude- & altitude-dependent)

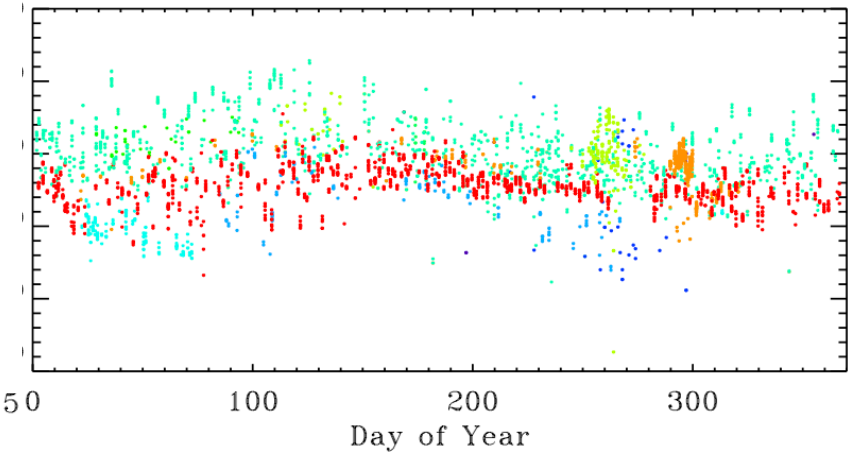
MkIV HDO & H_2O (color-coded by T)



OCS Columns

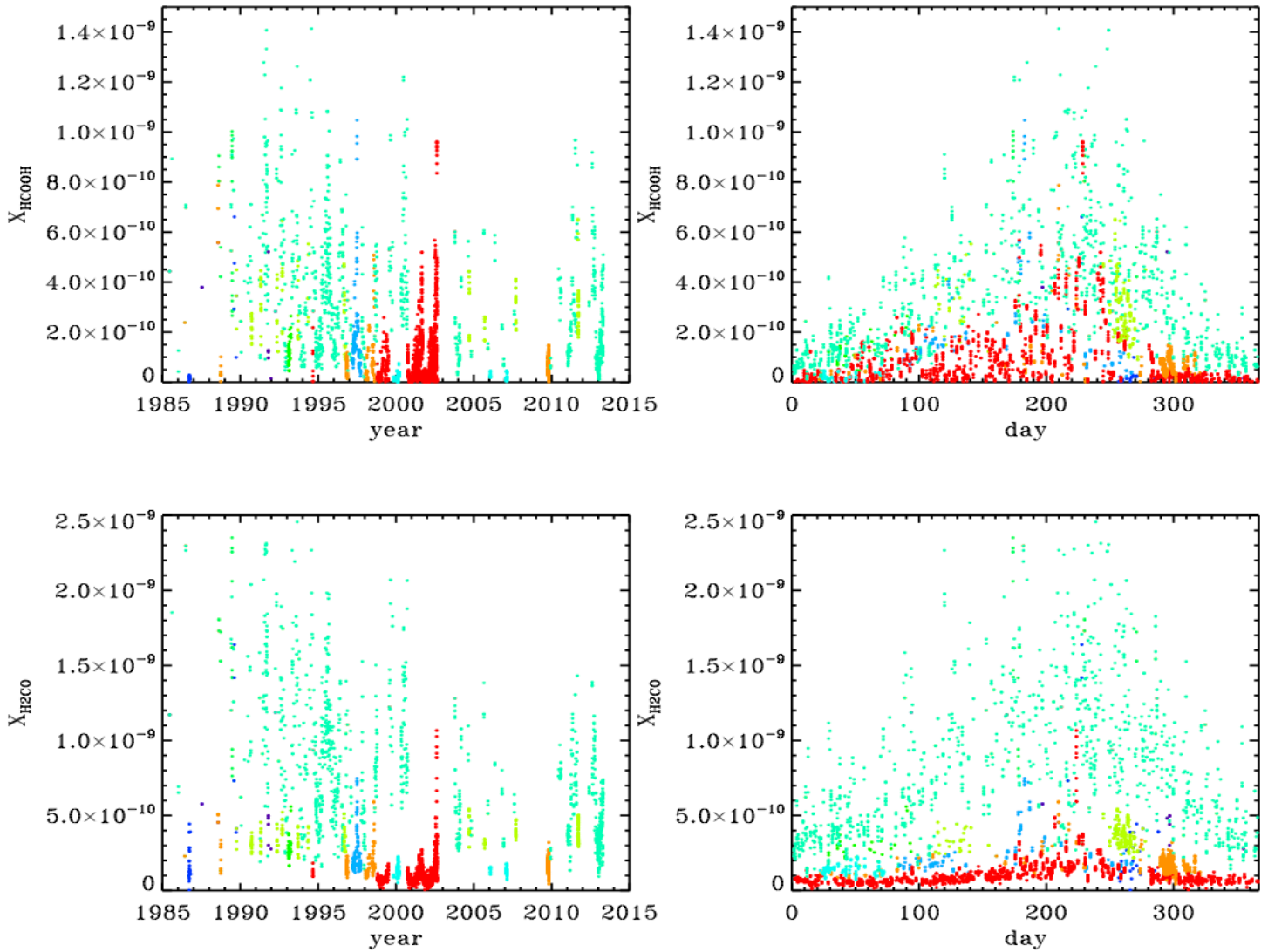




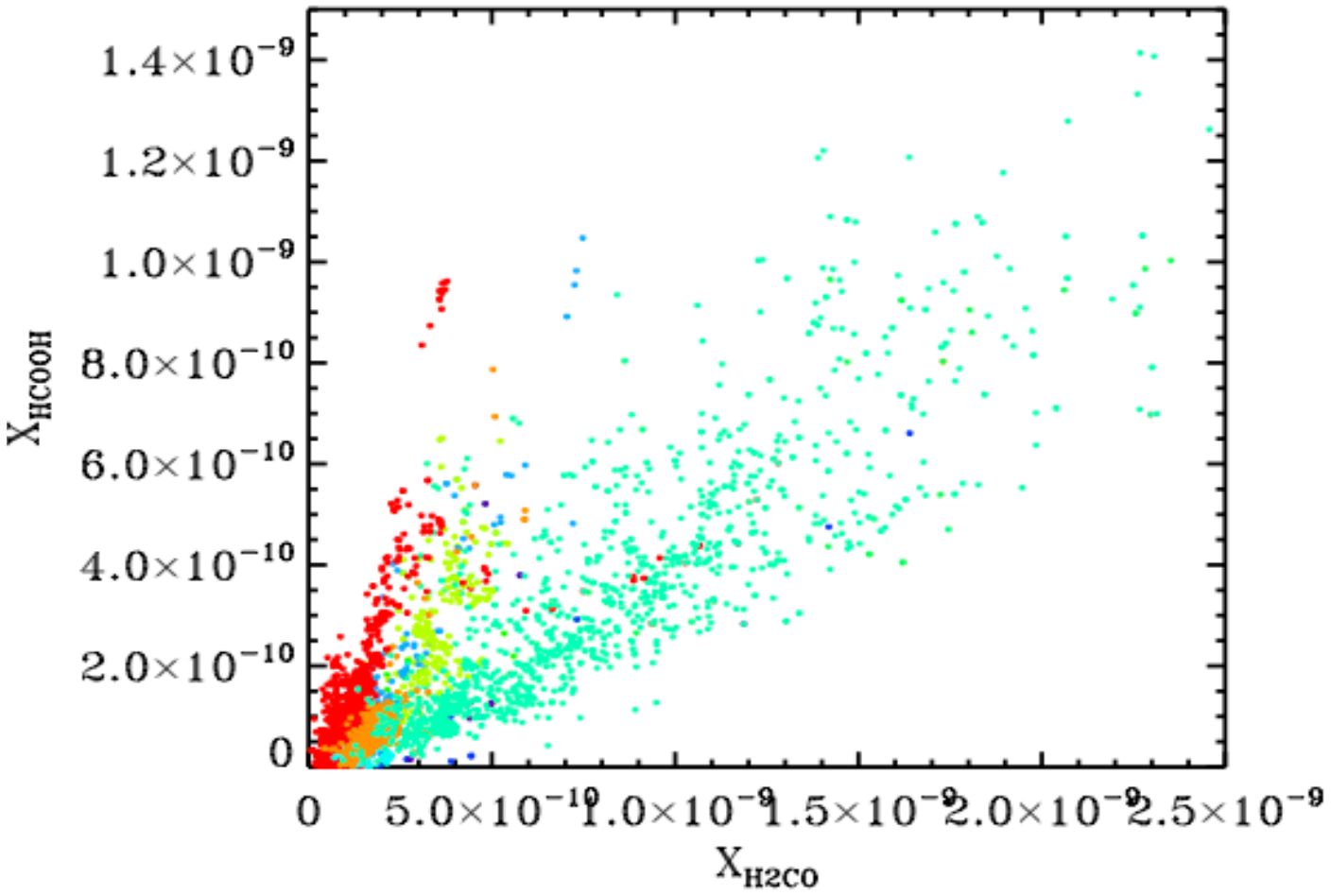


OCS exhibits a springtime maximum and autumn minimum.
Note also the large springtime variability compared with summer
Low values in polar winter vortices

HCOOH and H_2CO



HCOOH – H_2CO Correlation



Surprising that these two gases correlate well given their different lifetimes. Different slope to correlation at clean (high) and dirty (low) sites.

Publications & Presentations

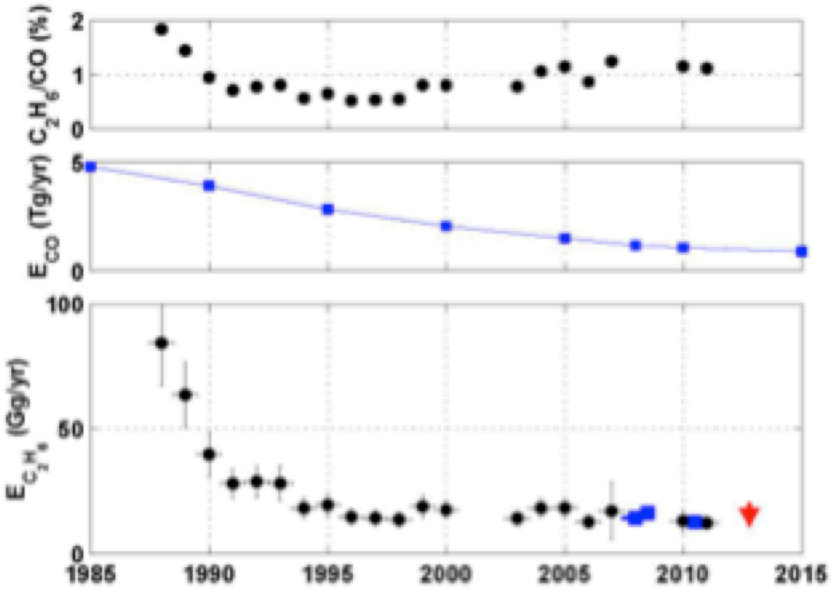
"**Methane and Ethane Total Column Measurements in the Los Angeles Basin**".
Wunch, Debra, Coleen Roehl, Jean-Francois Blavier, Norton Allen, Richard Treffers, Geoffrey Toon, Paul Wennberg,
AGU Fall Meeting, December 3-7, 2012

"**Intercomparison of Total Column Ozone Observations From S-NPP OMPS and Ground-Based IR FTS During Summer and Fall of 2012**",
Bhaswar Sen, Megan Novicki, Wen-Hao Li, Geoffrey Toon, Jean-Francois Blavier, Nicholas Jones, Clare Murphy, David Griffith, Mathias Palm, Justus Notholt and Lawrence Flynn,
American Meteorological Society Meeting, Jan 2013

"Carbonyl sulfide (OCS) variability with latitude in the atmosphere"
Gisèle Krysztofiak,et al.
Submitted to Atmosphere-Ocean, 2013

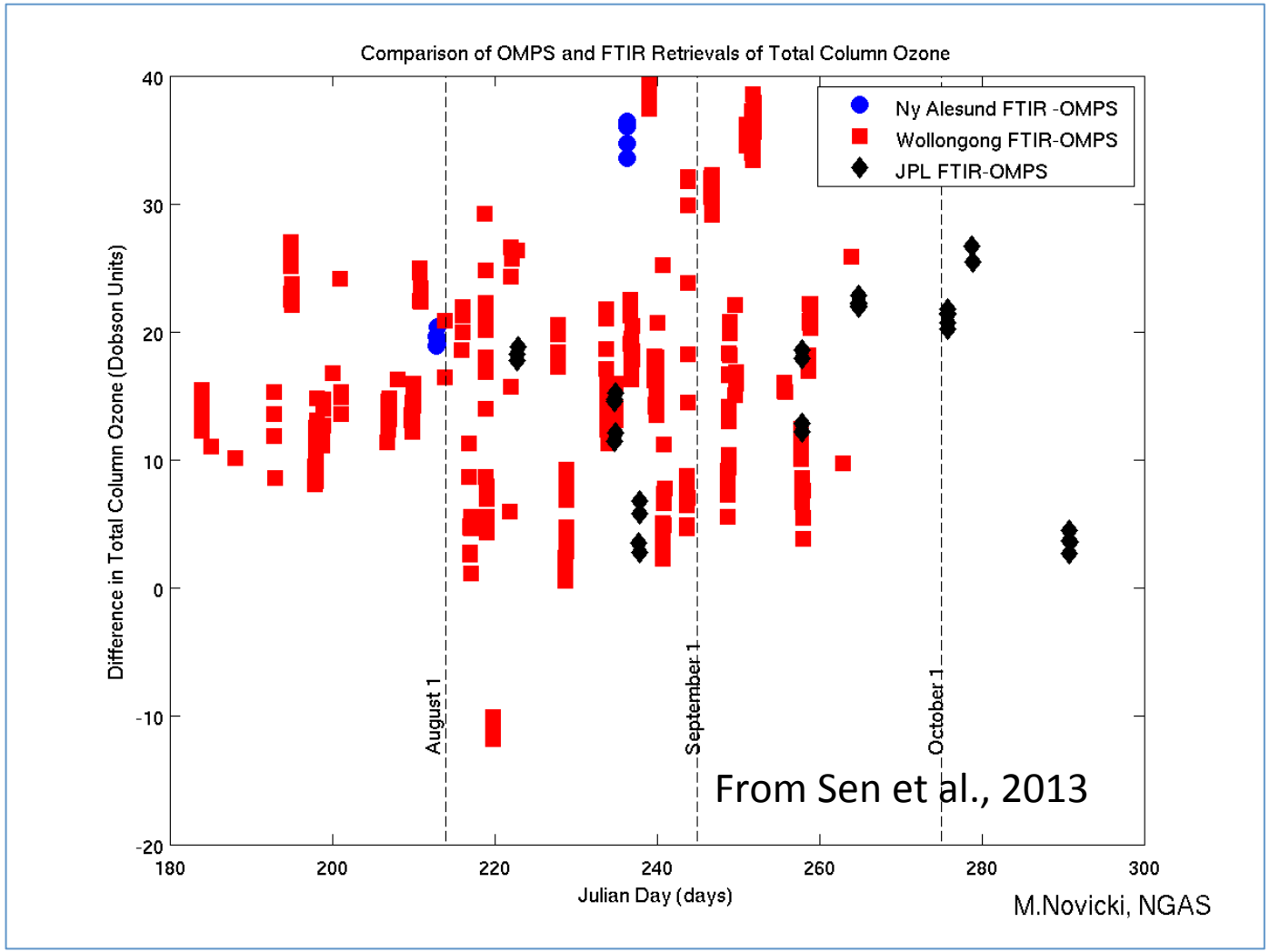
Ethane Emissions in the South Coast Air Basin

- The MkIV Fourier transform spectrometer has measured C_2H_6 and CO in the south coast air basin since 1988
- Using the reported CARB CO emissions, C_2H_6 emissions can be calculated
- Blue squares are in situ measurements reported in Hsu et al. (2010) and Wennberg et al. (2012); red triangle is from new measurements



From Wunch et al., 2012

Relative Difference Between OMPS and Ground-Based FTIR Total Column Ozone Observations



Other IRWG–related activities in past year

Participated in evaluation of HITRAN 2012 linelist. Used beta release to fit:

- MkIV Balloon & ground-based spectra (700-4800 cm-1)
- TCCON ground-based (v> 4800 cm-1)
- Kitt Peak Lab spectra

Reported large residuals or instances where fits got worse as compared with HITRAN 2008.

Generated Pseudo Linelists for:

- CH_3OH (900-1150 cm^{-1}) from lab measurements of Harrison & Bernath
- C_3H_8 (680-1550 cm^{-1}) from lab measurements of Sung et al
- C_3H_8 (2770-3075 cm^{-1}) from lab measurements of Harrison & Bernath

Conclusions

Late 2012, NASA continued funding of MkIV task for another 4 years.

Instrument continues to make high quality ground-based observations from JPL.

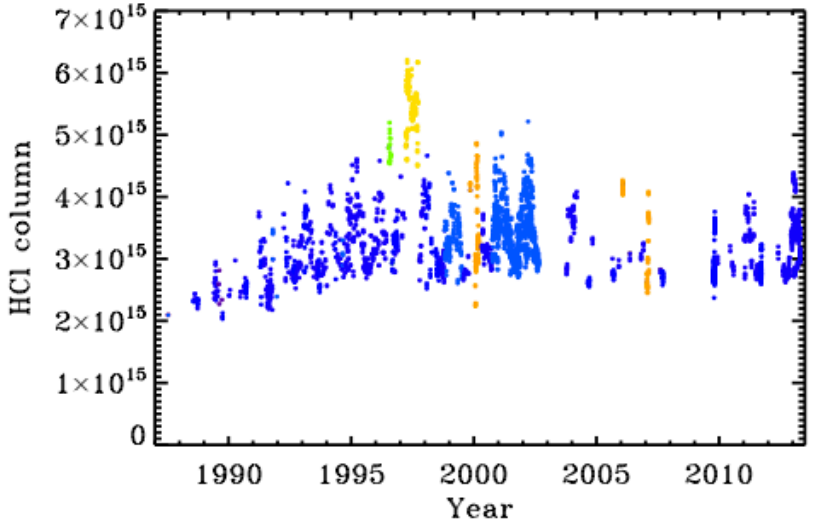
50 observation days in past 10 months.

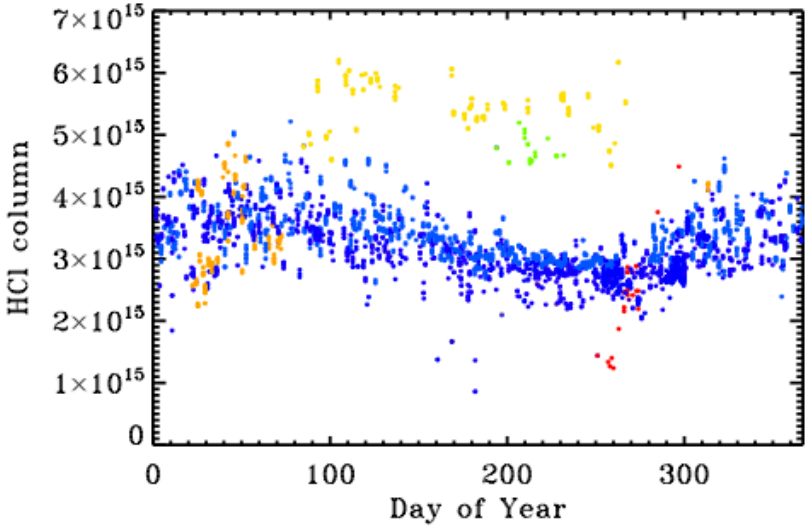
Next balloon flight planned for September 2014.

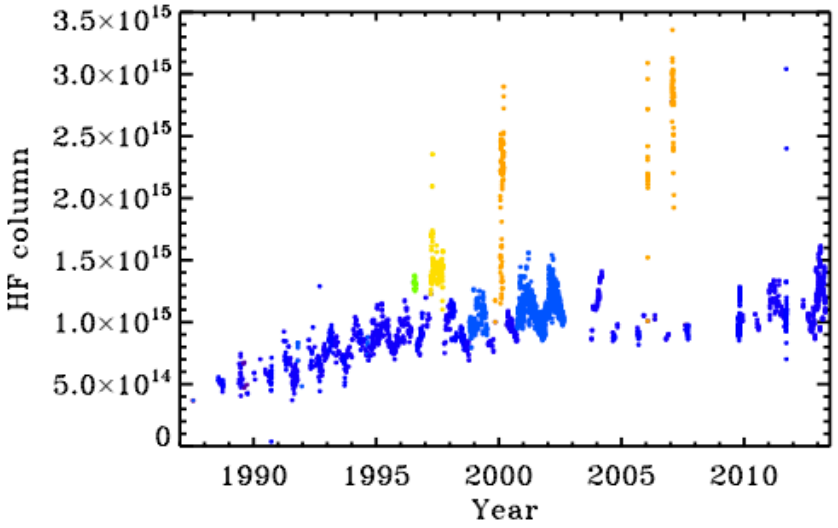
Trends are more difficult to identify/quantify in MkIV dataset because instrument keeps changing location.

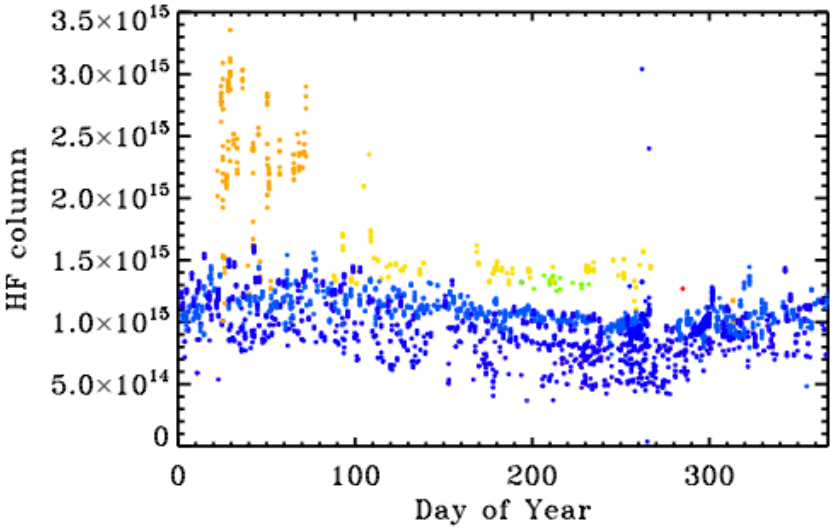
But dataset perhaps allows a more thorough evaluation of global models than could be achieved by a single fixed site.

HCl and HF (color-coded by latitude)

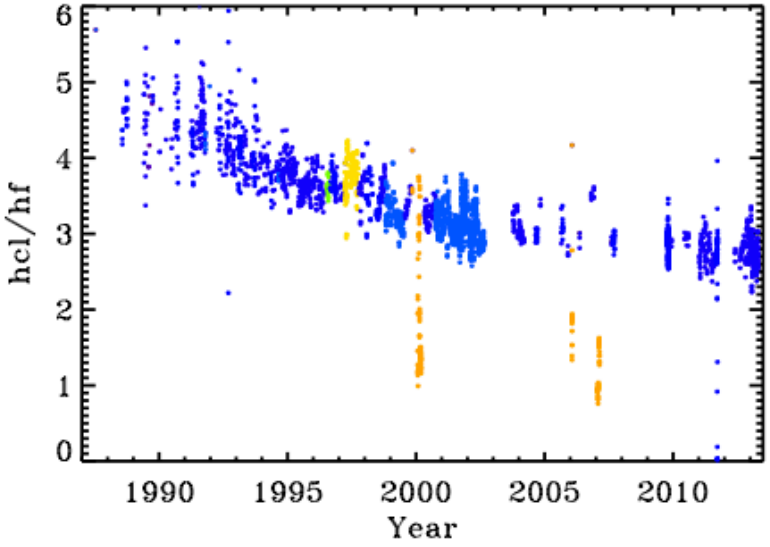


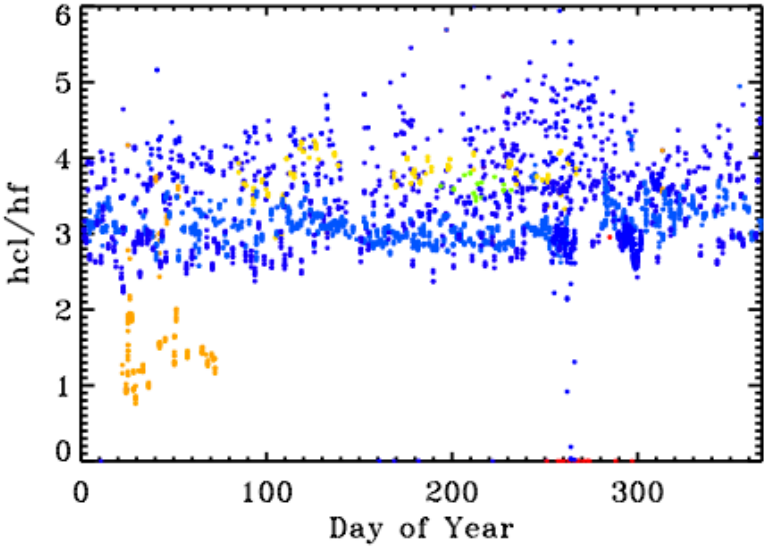






HCl/HF Ratio


hcl/hf
0
1
2
3
4
5
6
1990
1995
2000
2005
2010
Year


hcl/hf
0
1
2
3
4
5
6
0
100
200
300
Day of Year